University of California
Lawrence Livermore National Laboratory

Biology and Biotechnology Research Directorate

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Our biological research helps to understand disease and to lower health-care costs

Mission

The Biology and Biotechnology Research Directorate, which stems from our work on the biological effects of radiation, conducts basic and applied research in the health and life sciences in support of national needs and to understand the causes and mechanisms of ill-health effects, prevent disease, and lower health-care costs. Knowledge gained and the science and technology developed are transferred to research institutions, industry, universities, and other agencies so that the general public can benefit directly and rapidly from our advances.

Fields of Research

Livermore continues to make many important and unique contributions in the field of bioscience and biotechnology. This success results from our ability to bring together, at one laboratory, multidisciplinary expertise in biology, chemistry, high-performance computing, and advanced instrumentation and engineering as well as access to such unique experimental facilities as Livermore's Center for Accelerator Mass Spectrometry. Our activities fall under four programs:

- **Genomics:** Livermore is one of three DOE Human Genome Centers. We develop recombinant DNA clones, DNA mapping and sequencing techniques, and instrumentation and informatics tools to characterize the genes of humans, microorganisms, animals, and plants. By combining Livermore's multidisciplinary skills and weapons engineering capabilities, Livermore teams have developed critical instrumentation such as high-speed flow cytometers. Such instrumentation, used in conjunction with Livermore expertise in high-performance computing and biotechnology, has rapidly accelerated the pace and extent of our Human Genome Project.
- **Health Effects:** As part of our historical program to study the effects of nuclear weapons, Livermore developed techniques for biological dosimetry that are now used to assess biologically relevant exposure to toxic agents, carcinogens, and mutagens. Our current health-effects research integrates studies in DNA repair, the genetics of cancer susceptibility, and biodosimetry.
- **Structure–Function Analysis:** In studies related to cancer and human disease, we investigate, on the molecular level, proteins that are responsible for maintaining the integrity of the human genome, the effects of defective protein production or function, and the damage produced by small molecules that bind to and alter DNA.
- **Health Care:** The Center for HealthCare Technologies focuses multidisciplinary, multiprogram efforts on novel applications of Livermore-developed technologies for the diagnosis, treatment, and/or prevention of disease, for minimally invasive medicine, and for information management.

National Assets

- Human Genome Center.
- Center for Healthcare Technologies.
- Integrated structural biology.
- Genetic toxicology and biomonitoring.
- Bioinstrumentation and bioinformatics.

Recent Accomplishments

- Completion of the map of human chromosome 19 and identification of more than 250 new genes on this chromosome.
- Discovery of the structural defect resulting in myotonic dystrophy (leading to the first DNA-based diagnostic for this disease), the cause of one form of dwarfism, and a gene for cancer-susceptibility due to sun exposure.
- Measurement of extremely low levels of DNA damage in mice and humans using Livermore's Center for Accelerator Mass Spectroscopy; these levels of DNA damage are realistic with common environmental or workplace exposures.
- Development and transfer to industry of a number of biomedical technologies, including a high-speed flow cytometer and sorter, our "chromosome paints" technique for identifying chromosomal abnormalities, and a digital mammography instrument design.
- Significant improvement in the collection of x-ray diffraction data by cooling protein crystals to 125 K (–148°C), making possible the highest-resolution (1.0-Å) dataset ever achieved for a single crystal of a protein.

Benefits to the Nation

Livermore's Biology and Biotechnology Research Directorate is an acknowledged world leader in molecular genetics and genomics, human mutation and health risk assessment, molecular toxicology, and bioinstrumentation development. Using the multidisciplinary advantages at Livermore, we play a major role in the National Human Genome Project to decipher the human genetic code. The technological resources we develop and the scientific information we generate are made available to scientists throughout the world. Together with Livermore's Center for Accelerator Mass Spectrometry, we are the national source for biomedical accelerator mass spectrometry measurements. We are also the national leader in the quest to understand the cancer risks that result from consuming carcinogens created by cooking typical foods of the American diet. Through our Center for HealthCare Technologies, many of the defense technologies developed at Livermore are being adapted to create new methods for disease diagnosis, treatment, and prevention, providing improved capabilities, reduced costs, or both.

Contact

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